COHERENT SOFT X-RAY 2: HIGH COHERENT FLUX AND FULL POLARIZATION CONTROL BEAMLINE (CSX2)

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NATIONAL SYNCHROTRON LIGHT SOURCE II project beamlines • funded by DOE

TECHNIQUES AND CAPABILITIES

The Coherent Soft X-Ray beamline will provide high coherent flux (HCF) and full control of the polarization (PC) with two operational independent highly optimized branches.

Beamline specifications

•Source: dual 49 mm period EPU, 38 periods each, canted (PC), inline-phased (HCF)

•Energy range: 200-2000* eV (*polarization dependent).

•Resolving power: $E/\Delta E=1\times10^4$ (PC), 2×10^3 (HCF).

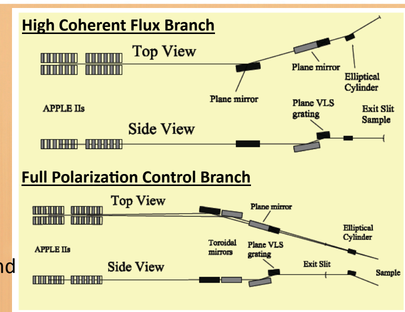
•Photon flux: 10^{13} photons/s circularly polarized (PC), coherent (HCF).

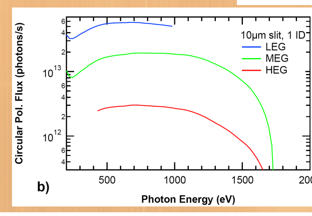
•Spot size: v x h (µm x µm): 20 x 20 (HCF) at 500 eV, 10 x 50 (PC), and 5 x 5 (PC, refocused).

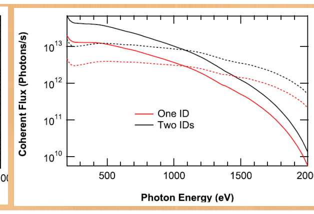
•Variable speed polarization switching up to 1000 Hz.

Available Techniques

- Coherent x-ray scattering
- Polarization dependent spectroscopy and scattering
- Ultrafast dynamics
- X-ray photon correlation spectroscopy
- Coherent diffraction imaging and ptychography

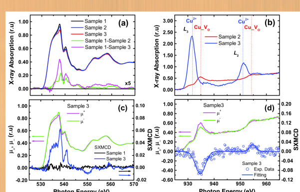






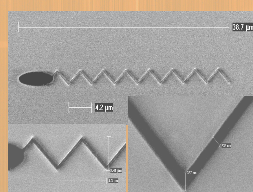
R. Reininger, K. Kriesel, S. Hulbert, C. Sánchez-Hanke, and D. Arena, Rev. Sci. Instrum. 79, 033108 (2008).

APPLICATIONS



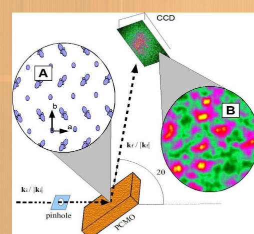
Ferromagnetism in diluted magnetic semiconductors. Such materials are interesting because of their potential to be used in spintronic devices. The figure shows Soft X-ray Magnetic circular dichroism (SXMCD) performed on Cu doped ZnO thin films demonstrating the ferromagnetic behavior of these samples. SXMCD measurements together with theoretical calculations demonstrate the intrinsic character of the effect.

T. S. Herng, *et al*, PRL **105**, 207201 (2010)



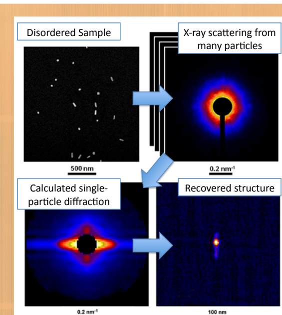
Understanding the dynamics of magnetic domain wall propagation in low dimensional ferromagnetic systems is fundamental to optimize the performance of magnetic based memories or logic devices. Timing experiments using XMCD (X-ray Circular Dichroism) as magnetic contrast allows to study with element specificity the behavior of the domains walls propagation. Because of the reduced sizes and dimensionality these experiments require high photon flux.

(Figure courtesy T. Hase, University of Warwcik)



Dynamics in strongly correlated systems studied with coherent soft x-rays. In these systems the coupling is complicated due to interplay among the charge, the spin and the lattice. Working in the time domain with coherent soft x-rays allows to study the dynamics in the systems in temperature driven phase transitions. The figure above shows the experimental set- up and data collected under Bragg conditions in a half doped $Pr_{0.5}Ca_{0.5}MnO_3$.

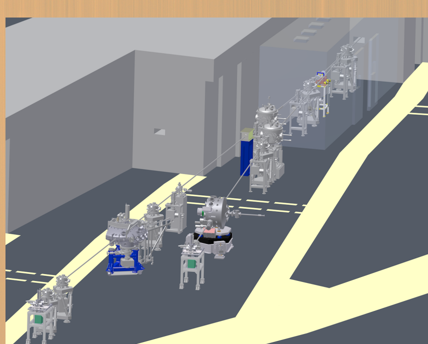
J. J. Turner, *et al*, *New Journal of Physics* 10, 053023 (2008).



Structure of biological molecules from disordered ensembles. Resolving the structure of biological molecules requires many identical copies. These structures can be resolved by means of coherent x-rays as is explained in the figure above. This will allow structural studies of proteins that are difficult to crystallize in a more natural state in aqueous solution.

D. K. Saldin, *et al*, *PRL* 106, 115501 (2011).

SPECIFIC PROJECTS / ADDITIONAL INFORMATION



- There are currently two end stations which match the capabilities of the CSX beamline
- The TARDIS endstation which is currently situated at the NSLS X1A2 beamline matches the capabilities of the HCF branch. It features a six-circle, in-vacuum diffractometer, helium cryostat (down to 5K), zone plate focusing to 30 nm and channeltron and CCD detectors
- A endstation designed for NSLS X13A beamline matches the capabilities of the PC branch. The chamber, features an in-vacuum reflectometer, a 1T in-house designed superconducting vector magnet currently under construction, sample transfer, and sample cooling capabilities down to 20 K